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Biological Evaluation of Douglas-fir Tussock Moth Populations Baxter Sawmill Site, Ogden RD Wasatch-Cache NF

1991

by
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ABSTRACT

The Ogden Field Office of Forest Pest Management conducted a survey of 1,500 acres near the old Baxter Sawmill of the Ogden Ranger District. The survey objective was to determine the population levels and potential impacts of Douglas-fir tussock moth in the area. Extensive defoliation and high population levels were found throughout the survey area. Predictions indicate that 53 % of the survey area will receive total tree defoliation resulting in some tree mortality.

INTRODUCTION

The Douglas-fir tussock moth, *Orgyia pseudotsuga* McDunnough, is an important defoliator of true firs and Douglas-fir in western Northern America. Populations of tussock moth can increase dramatically in a very short period of time, sometimes leading to top-kill and tree mortality over extensive areas. Outbreaks appear to develop almost explosively, and then usually subside after a year or two. There are numerous natural mortality factors which cause the decline of tussock moth populations. A nuclear polyhedrosis virus (NPV) is one of the most commonly observed mortality factor (Brookes et al 1978). There are also over sixty insect species which parasitize tussock moth in addition to predation by other insects and birds.

Defoliation by the tussock moth will weaken trees and retard growth for several years. In heavy or prolonged infestations, topkill and tree mortality will occur. Trees defoliated by Douglas-fir

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tussock moth are susceptible to attack by bark beetles. Integrated pest management strategies may need to be employed where resource values are high and/or where the effects of tussock moth will interfere with management objectives.

Situation on the Ogden RD

Increasing populations of Douglas-fir tussock moth on the Wasatch-Cache NF, Ogden RD, have been detected during aerial surveys this past year. Tussock moth had reached outbreak levels (i.e. >20 larvae/1000 sq. in. of foliage) in certain locations on the Ogden RD, but the extent of the infested area was unknown. Population survey plots were established within the infested area in November - December of 1990 to determine expected 1991 defoliation levels. Population levels were determined using a pupal (cocoon) counting developed by Mason (personal comm.). The purpose of pupal sampling was to determine (1) the extent of the outbreak; (2) the density of tussock moth populations over the outbreak area; and (3) the expected defoliation for 1991.

Life History of Douglas-fir Tussock Moth

The tussock moth has one generation annually. Adults are present from late July to early September. The female moth only has small wings and does not fly. The female, following emergence from the pupal case, emits a chemical scent (pheromone) to attract male moths. After mating, the female lays her eggs on top of the pupal cocoon from which she emerged. Egg masses vary in size from a few eggs to as many as 350 in one to three layers in the mass. The eggs overwinter and hatch in late May to early June, coinciding with bud burst and shoot elongation of the host trees. At first, larvae feed on newly developing needles. As the larvae mature, they feed on both new and old foliage. Since the female moth does not fly, major dispersal is by windborne young larvae. The young larvae drop off foliage, producing long silken threads which allow them to become windborne. Larvae are present and feeding on foliage for four to six weeks in late June to August. Tussock moth larvae generally have six instar stages (molts) prior to pupation. Pupation occurs any time from late July to late August and lasts approximately two weeks. Adults then emerge to continue the life cycle.

METHODS

Sampling locations and hosts

A "core" area had been previously established as having high tussock moth populations, where defoliation was moderate to high. This area extends from south of Rock Creek, north of Curtis Creek, just west of Baxter Sawmill and east to State Lands section 36, figure 1. This area includes lands under various ownerships including U.S. Forest Service, private, and state lands.

There are several smaller areas surrounding the core area with light to moderate defoliation. Again, several land ownerships are involve. Pupal sampling was conducted throughout the host type in all previously mapped defoliated areas.

The host type sampled was pure stands of single, or multi-storied canopy subalpine fir, *Abies lasiocarpa*, and Douglas-fir, *Pseudotsuga menziesii*, and mixed conifer stands containing 20 percent or more of the trees in host species.

Sampling intensity and lower crown sampling method

Plots were located throughout the areas in a systematic sampling layout. Road and trail systems were utilized to locate plots where applicable. Plots were placed at 15 chain intervals on two transacts in the generally infested areas. Satellite plots were established in other areas of host types. (Figure 1.)

Sampling of pupal populations was conducted by "walk-through" examination. At each sampling location (plot), a two-person crew selected 20 host trees that had foliage which could be reached from the ground. A tree of almost any height is acceptable so long as accessible sample branches had new growth in the spring. Sampling the tops of small trees was avoided. A "sample" consisted of three 18-inch branch tips examined on each sample tree. Each person on the crew sampled 10 trees on a plot (20 trees per plot).

The undersurface of the apical 18 inches of the branch was examined to determine the total number of cocoons and egg masses for three different branches. The total number of tussock moth pupae and egg masses found on the tree branch tips was recorded for each tree on the plot. After all trees had been examined, an overall defoliation estimate of the plot trees was determined. Defoliation was classed: zero, light, moderate, and heavy defoliation. These categories were defined as follows:

> *Light defoliation* - 10-35 percent needle loss. Top 10 percent of the crown is totally defoliated or branches are completely stripped of needles in the top quarter of the crown.
>
> *Moderate defoliation* - 40-65 percent, top half of the crown is totally defoliated. There is significant feeding on older needles at this level of defoliation.
>
> *Heavy defoliation* - 70 percent or greater. There is heavy feeding on older foliage and all new foliage is removed.

A total of 53 plots were sampled. Six sample plots were in non-host type, reducing the sample size to 47 plots. In the spring of 1991, tussock moth egg masses will be collected for laboratory rearing. This evaluation will help determine incidence of naturally-occurring virus in eggs, incidence of parasitism, and egg viability.

Data Analysis

The data collected from the field in December of 1990 was compiled and summarized using LOTUS 1-2-3 software. After the data was input, conversions were performed to predict the number of mid-crown early larvae per 1000 sq. in. of foliage from the number of lower crown cocoons using a regression equation. The regression equation was developed by Dick Mason, Insect Ecologist, for pre-outbreak (before detectable defoliation) population levels of douglas-fir tussock moth. The number of mid-crown early larvae per 1000 sq. in. can be correlated to the amount of visible damage expected in the following growing season. The following interpretations were used from Mason's research:

> 0 - 20 mid crown early larvae per sq. in. = first evidence of defoliation
>
> 21 - 50 mid crown early larvae per sq. in. = heavy top defoliation
>
> 50 - 100 mid crown early larvae per sq. in. = moderate to heavy tree defoliation
>
> > 100 mid crown early larvae per sq. in. = total defoliation with some mortality

RESULTS AND DISCUSSION

In 1991, the results indicated the following:

- 32% of the area sampled would experience initial defoliation
- 4% of the area will receive heavy top defoliation
- 11% of the area will receive moderate tree defoliation
- 53% of the area will receive total tree defoliation resulting in some tree mortality.

Table 1, 2 and Figure 2 show more details. It should be noted that in addition to douglas-fir tussock moth defoliation, the area also has numerous subalpine fir dying due to western balsam bark beetles, *Dryocoetes confusus* Swaine, and fir engravers, *Scolytus ventralis* LeConte. The bark beetles are abundant as a result of tree stress created by drought and insect defoliation.

This survey design was developed for use in for use in endemic douglas-fir tussock moth populations, however the survey can be conducted on outbreak or epidemic populations. Our predications may over-estimate the levels of defoliation.

Previous site visits by Entomologists (Steve Munson and Dave Holland) found NPV in those areas with current heavy defoliation. The presence of the virus indicates that areas receiving heavy defoliation in 1990, may collapse in 1991. The virus was noted within numerous pupal cases, which results in no adult emergence. The virus will also affect the eggs, so egg viability and larval survival may be reduced in 1991.

Since this is the first year of heavy defoliation on the Ogden RD, one or two more years of defoliation may occur before the tussock moth population collapses.

Management Options

There are several management options available.

1. No-action: An extended tussock moth outbreak (two or more years) could result in heavy mortality and topkill of all size and age class trees. Fir mortality will continue as long as the outbreak persists. Even if the outbreak subsides, it will take two to three years for the residual trees to recover. Western balsam bark beetle and fir engraver populations already present in the area, will result in additional fir mortality. Generally, populations collapse following two years of heavy defoliation.

Increased fire hazard can be a result of this alternative. Pest related tree mortality increases fuels for fire. Increased fire surveillance may be necessary as a result of increased tree mortality.

2. Direct treatment: The affected area could be treated with either chemical insecticides or biological insecticides, such as *Bacillus thuringiensis* (*B.t.*). Suppression of the insect population is possible with such materials, however, such suppression does not reduce the potential risk of future tussock moth outbreaks. This option is a costly investment and typically reserved for high value areas only. Spraying is not a viable option in low value timber stands.

3. Sanitation/Salvage Logging: Removal of top killed and severely defoliated trees will reduce stand susceptibility to bark beetle attack. Trees which exhibit these characteristics are under severe stress, thus increasing their vulnerability to fir engravers and western balsam bark beetles already present in the area. However, this alternative will not significantly reduce tussock moth populations. This option would reduce the fire hazard and utilize the dead wood.

4. Prevention of Outbreaks: The most common preventive treatments are usually silvicultural practices that either reduce or eliminate the threat of tussock moth outbreaks. Host species growing on warm, dry sites or on sites not suited to their vigorous growth are most suspectible to tussock moth infestations. Stands that are healthy, thrifty, and growing on their proper sites are less likely to sustain tussock moth outbreaks. They are also less vulnerable to permanent damage should outbreaks occur.

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LITERATURE CITED

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Table 1. Sample summary

Category of defoliation	Number of plots	Percent of total	Number of trees sampled	Average mid-crown larvae/1000 sq.in.
First evidence	15	31.9	300	8.3
Heavy top	2	4.3	40	36.2
Moderate	5	10.6	100	77.8
Total tree	25	53.2	500	500.0

Table 2. Bar chart of expected 1991 defoliation levels.

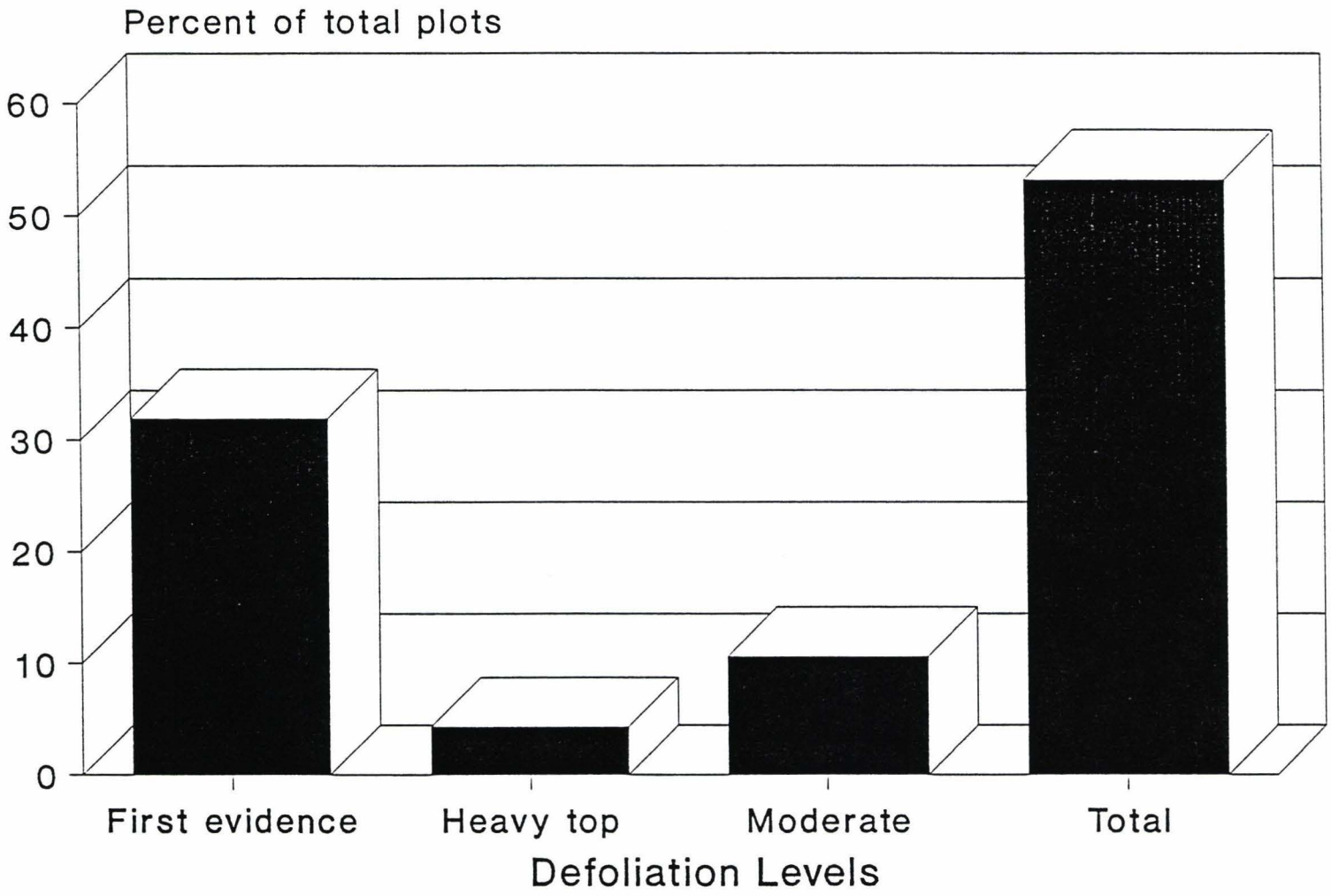

Figure 1. Douglas-fir tussock moth sample plot map

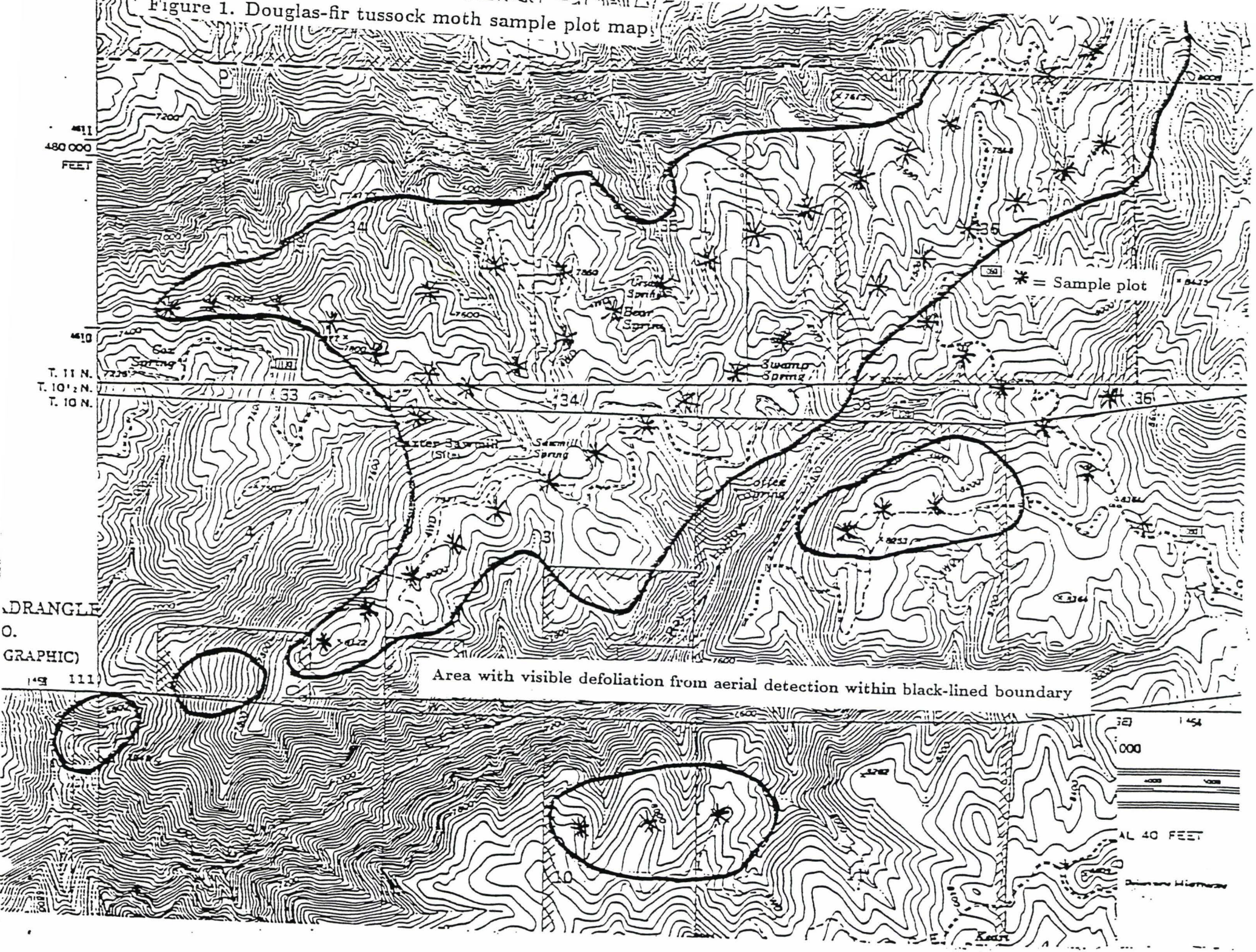

Figure 2. Levels of expected defoliation in 1991